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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/056,154	01/23/2002	Vincent Fortin	M12524 US	2279

7590 04/15/2003

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EXAMINER
LEE, HSIEN MING

ART UNIT	PAPER NUMBER
2823	

DATE MAILED: 04/15/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/056,154	FORTIN ET AL.	
	Examiner	Art Unit	
	Hsien-Ming Lee	2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *11 March 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1 and 3-25* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1 and 3-25* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Remarks

1. The request for RCE filed 3/11/03 is acknowledged.

2. Claims 1 and 3-25 are pending in the application.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claims 17 and 20 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. The as-filed specification neither teaches nor suggests how the reacting act would cause *oxygen in the silicon oxide layer* to dissolve in the *titanium* layer. In particular, the instant invention merely teach depositing the cobalt layer (120) on the silicon oxide layer (320); and depositing the titanium layer (130) on the cobalt layer (120). How can the oxygen in the silicon oxide layer (320) dissolve in the titanium layer (130) when the titanium layer (130) does *not contact* with the silicon oxide layer (320) ?

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 1, 4, 6-8, 11, 12, and 14-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hu (US 6,392,302) in view of Fortin (US 6,503,824).

In re claims 1, 4, 7, 8 , 15, Hu teaches the claimed method for forming cobalt silicide on a body which has a surface that comprises silicon 18, the method comprising:

- forming a cobalt layer 26 on the silicon surface 18 (Fig.4);
- forming a titanium layer 28 (thickness: approximately 100 Å) over the cobalt layer 26, wherein the titanium layer 28 is deposited on the cobalt layer 26 to be in contact with the cobalt layer 26 (Fig.4);
- reacting the cobalt layer 26 with the silicon surface 18 to form cobalt silicide 30 (Fig.5) and
- removing the titanium layer 28 and un-reacted cobalt layer 26 (Fig.5).

Hu does teach that the titanium layer 28 is formed by a physical vapor deposition (PVD) but does not expressly teach that the PVD is an ionized physical vapor deposition (IPVD) and the body is attached to a support biased with an AC power of 0 W.

However, Fortin in an analogous art teach utilizing IPVD for forming the titanium layer would achieve the advantages of improving bottom and sidewall coverage in deep opening. (col. 1, line 65 through col.2, line 7). The IPVD uses AC as bias source and the bias power is set to zero in deposition (col.1, lines 36-37; col.3, lines 40-43; col.2, lines 24-38).

Therefore, one of the ordinary skill in the art, at the time the invention was made, would have been motivated to utilize the IPVD method as suggested by Fortin for forming the PVD-deposited titanium layer of Hu since by doing so it would provide improve step coverage in the deep opening. (col. 1, line 65 through col.2, line 7, Fortin)

In re claim 6, Hu in view of Fortin also teach that at least part of a sidewall surface 24 of the opening is made of a dielectric (i.e. TEOS). (col. 4, lines 18-20, Hu)

In re claim 11, Hu in view of Fortin also teaches that the forming acts are performed in a chamber at below-atmospheric pressure (i.e. a pressure of 33 m Torr; col.2. lines 61, Fortin) without exposing the body to atmospheric pressure between the forming acts.

In re claim 12, the selection of the thickness of the titanium layer is obvious because it is a matter of determining optimum process condition by routine experimentation with a limited number of species. In re Jones, 162 USPQ 224 (CCPA 1955)(the selection of optimum ranges within prior art general conditions is obvious) and In re Boesch, 205 USPQ 215 (CCPA 1980)(discovery of optimum value of result effective variable in a known process is obvious). For example, the thickness of the titanium layer is determined by the dimension of the device and the aspect ratio of the opening. In this case, applicant is required to demonstrate the criticality, generally by showing that the claimed thickness range would achieve unexpected results relative to the prior art range. See M.P.E.P. 2144.05 III

In re claim 14, Hu in view of Fortin teaches that the ionized physical vapor deposition is performed in a chamber with the body situated on a pedestal coupled to a bias source that provides AC current for helping ionize gas to produce gas ions that dislodge titanium from a titanium target in the chamber. (col. 1, lines 36-42, Fortin)

In re claim 16, Hu in view of Fortin also teaches that the body comprises a region consisting largely of silicon 10 a silicon oxide layer 24 extending along the silicon region 10 (Fig. 3); the method includes, prior to the forming acts, removing at least part of the silicon oxide layer to substantially expose at least part of the silicon region 10 (i.e. forming the oxide spacers 24 to

expose the silicon region 10); and at least part of the cobalt layer 26 is formed along the silicon region 10 where it is substantially exposed (Fig.4, Hu).

In re claim 18, Hu in view of Fortin further teaches that the body comprises a first region comprising silicon 10 and a second region 24 situated on the first region 10, an opening extending through the second region down to the first region 10; the cobalt layer 26 extends at least into the opening down to the first region; and the titanium layer 28 extends at least into the opening above material of the cobalt layer 26 at the bottom of the opening (Fig.4, Hu).

In re claim 19, Hu in view of Fortin also teaches that the method includes, prior to the forming acts, removing material of the silicon oxide layer 24 at the bottom of the opening to substantially expose the silicon substrate region 10 at the bottom of the opening; and at least part of the cobalt layer 26 is formed along the silicon substrate region 10 at the bottom of the opening (Fig.4, Hu).

In re claims 17 and 20, Hu in view of Fortin also teaches that the body comprises a region consisting largely of silicon 10 and a silicon oxide 24 layer situated along the silicon region 10; the reacting act includes oxygen in the silicon oxide to dissolve in the titanium layer 26.

7. Claims 3, 5, 13, 21 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hu (US '302) in view of Fortin (US '824) as applied to claims 1, 4, 6-8, 11, 12 and 14-20 above and further in view of D'Couto et al. (US 6,342,133).

In re claims 3 and 13, Hu in view of Fortin teaches the claimed method, as stated above, but does not teach that the distance between a titanium target and the body is at least 140 mm during the titanium layer deposition.

However, D'Couto et al. in an analogous art of IPVD deposition teach that the distance between the titanium and the substrate (i.e. the body) can be 215 to 240 mm (col.6, lines 18-28), which is determined by the considerations of the layer uniformity and avoiding charging damage (col. 9, lines 4-43).

Therefore, it would have been obvious to one of the ordinary skill in the art at the time the invention was made to select a proper distance between the titanium target and the body as taught by D'Couto et al. in the IPVD method of Hu in view of Fortin to be at least 140 mm since by this manner it would form a uniform titanium layer and prevent the body from charging damage. (col. 9, lines 4-43, D'Couto et al.)

In re claims 5, 21 and 22, Hu view of Fortin teaches the claimed method, as stated above, but does not expressly teach that the opening has an aspect ratio of at least 2.5 (claims 5 and 22) or at least 1.3 (claim 21).

However, the IPVD technique is a directional deposition method, which is known to the application of deep opening, as evidenced by D'Couto et al. In particular, D'Couto et al. teach utilizing the IPVD for depositing the titanium layer in the deep opening having an aspect ratio of 5 (col.5, line 44 through col.6, line 6).

Therefore, it would have been obvious to one of the ordinary skill in the art at the time the invention was made to apply the method of Hu in view of Fortin to the situation of the opening having the aspect ratio of at last 2.5 as taught by D'Couto et al. since the IPVD method is a good candidate for better step coverage in such high aspect ratio. (col. 5, line 61 through col.6, line 6, D'Couto et al.)

8. Claims 9-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hu (US '302) in view of Fortin (US '824) as applied to claims 1, 4, 6-8, 11, 12 and 14-20 above and further in view of Liu et al.(US 6,329,277).

Hu in view of Fortin teaches the claimed method, as stated above, but fails to teach heating the body and cobalt silicide layer to reduce the resistivity of the cobalt silicide layer, wherein the heating act comprises rapidly thermally annealing (RTA) the body and cobalt silicide layer.

However, Liu et al. in an analogous art forming cobalt silicide teach subjecting the cobalt silicide to the RTA for reducing the resistivity of the cobalt silicide. (col.4, lines 12-15, 56-58).

Therefore, one of the ordinary skill in the art, at the time the invention was made, would have been motivated to utilize the RTA as taught by Liu et al. after forming the cobalt silicide of Hu in view of Fortin since by doing so it would reducing the resistivity of the cobalt silicide. (col.4, lines 12-15, Liu et al.)

9. Claims 23-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hu (US '302) in view of Fortin (US '824) as applied to claims 1, 4, 6-8, 11, 12 and 14-20 above and further in view of applicants' admitted prior art (hereinafter referred as "AAPA").

Hu in view of Fortin teaches the claimed method, as stated above, but fails to teach that the body comprises an erasable programmable read-only memory region; and the cobalt silicide layer is formed to contact a doped monocrystalline silicon section of erasable programmable read-only memory region.

However, AAPA in Figs 1-2 and related text teaches that the body comprises an erasable programmable read-only memory region (i.e. MOS); and the cobalt silicide layer 210 is formed

to contact a doped monocrystalline silicon section 104 of erasable programmable read-only memory region.

Therefore, one of the ordinary skill in the art, at the time the invention was made, would have been motivated to apply the method of Hu in view of Fortin to the application of the erasable programmable read-only memory region formed on the doped monocrystalline silicon section as taught by AAPA since the method of Hu in view of Fortin is illustrative instead of restrictive. The aforementioned application is within the level of the ordinary skill and would not depart from the spirit and scope of the teachings of Hu in view of Fortin. In particular, Hu teaches that the method can apply to the manufacturing of memory device. (col. 6, lines 22-41, Hu)

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Hsien-Ming Lee whose telephone number is 703-305-7341. The examiner can normally be reached on M-F (9:00 ~ 5:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 703-306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

Hsien-Ming Lee
Examiner
Art Unit 2823

Lee
4/8/03